Manures

& Soil Analyses

Copy

Analytical Laboratory
79. Mark Lane
London, E.C. April 28th 1899.

Sample of Rubber Soil from Singapore
Marked Para rubber grows better on this soil than on Ceylon soils

Received from Mr. John C. Willis, Royal Botanic Gardens, Peradeniya, Ceylon

Composition in the air-dried Condition.

Water (lost @ 212°F)	6.288.
x. Organic Matter & volatile Combustible Substance	27.521
Oxides of Iron	3.198
Alumina	8.526
Lime	·272
Magnesia	·028
Potash	·093
Soda	·147
Phosphoric acid	·187
Sulphuric acid	·034
Carbonic acid	traces
Nitric acid	·001
Chlorine	·007.
Silica soluble in alkali	12.049
Insoluble Silicates & Quartz	41.635
	100.000
x Containing Nitrogen	·605
xx Containing Coarse Sand separated by washing	7.738.

Sd. John Hughes. Fellow of the Institute of Chemistry

(G 53)

Botanic Gardens. Singapore.

STRAITS SETTLEMENTS.

................................, 190

IIth June I906.

No. 238/06

Dear Sir,

Mr. Ridley will be away for perhaps the next three weeks and I briefly reply to your letter which I will also keep in view for Mr.Ridley's return.

If only ordinary clay soil is used for burning for the pepper gardens no good is likely to be effected, but I have always seen (and used) and understood pepper growers collected decayed leaves and top black soil from the jungle (the gradual accumulation) which was burnt and then applied. If due care is taken in what is collected this supplies a good percentage of lime and nitrogenous matter, and together with the humus a rich compost, easily assimilated, and of undoubted advantage to pepper vines.

Yours truly

for, Director of Gardens S.S

C. Sugden Esq

C/o Mess: Borneo Coy Ltd

Singapore

(1,000-Jan., 1905.)

Telephone Nº 347. Avenue.

HEAD OFFICE & BRANCHES
Telegraphic Address, "BORNEO."
Codes. A1. A.B.C. Lieber's. Scott's & Watkins.

BRANCHES.
SARAWAK. | BATAVIA.
SINGAPORE | BANGKOK.
CHIENGMAI.

LLOYDS AGENTS AT
BATAVIA.
BANGKOK.
SARAWAK.

Borneo Company Limited,
28, Fenchurch Street,
London, E.C. 17th May 1906

Claude Sugden, Esq.
Manager,
The Borneo Co. Ltd.
SINGAPORE.

Dear Sir,

In the cultivation of Pepper, burnt earth, as you are aware, is used as a manure. Four years ago we had a sample of it from Sarawak analysed here by Dr. Dyer, a leading authority in such matters. We enclose copy of his analysis, from which you will see he states that the earth he examined had no manurial value. We communicated this to our Kuching friends, but the use of burnt earth is still continued in the gardens on which we have made advances, the gardeners being firm believers that the earth is of great benefit to their vines. It may be that it performs some other important function for the plants than that of manuring them, of which we are unaware.

We shall be obliged if you will put the matter before the Head of the Botanical Gardens at Singapore, and ask him if he will kindly inform you what is the exact service, if any, that the burnt earth renders to the pepper. We can understand that some earths, according to their composition, might be of advantage to the vines, but we believe what is employed in

Sarawak is practically little else than clay.

If it is a mistake to believe that the use of burnt earth in our Sarawak gardens is advantageous, then a large economy might be introduced into the cost of production of the pepper by discontinuing its use; and at the present time espedially we need to study economy in every way possible, to carry on our gardens without serious loss.

Please advise Mr.Bryan, as well as ourselves, with regard to what you ascertain on this subject.

We are, Dear Sir,

Yours faithfully,

For THE BORNEO COMPANY LIMITED.

P. D. Thomson

Managing Director.

C O P Y.

Analytical Laboratory,
17 Great Tower Street,
London 2nd. May 1902.

RESULT OF ANALYSIS 717

Of a Sample of "Burnt Earth" (so labelled)

Sent by Messrs The Borneo Co., Ld.

Moisture (Loss at 212°Fah.)	12.80
Organic Matter	3.42
Phosphoric Acid	.03
Silicious Matter	76.53
Oxide of Iron and Alumina	6.42
Lime	traces
Magnesia, Alkalies, &c.	$80
	100.00

Nitrogen 09

This is a very poor earth, containing only traces of lime and phosphoric acid. It has no value whatever as a manure, for which purpose I understand it has been used.

(Signed) Berhard Dyer.

Singapore
11th June 1906

Dear Ridley,

Can you kindly give me any information on the point raised of what use is burnt earth. Perhaps it was originally intended as a warning to White ants.

Yours sincerely
C. Sugden

Analysis of Soils

Notes on various places from which samples come.

<u>Sample 1.</u> The place is not more than 1½ miles from the sea, and quite near to the river which is a tidal one, + consequently practically salt water at high tide. The land is not ordinarily flooded by river, but is only some 3 or 4 feet above it. It was used as <u>Padi land</u> some years ago, (<u>Sawah</u>) and is quite *damp at this dry time; being quite a swamp, though not a heavy one, in anything but dry weather.

x In taking the [illegible] water at 18 [illegible]

The jungle on the land side is fairly large trees, but the cleared land is covered with scrub, + rushes or small palms, there being no decent trees of second growth on it. A few cocoanuts, apparently old trees, are small + poor looking. The sample was taken close to the river + near the cocoa-nut trees.

<u>Sample 2.</u> This land is about 4 or 5 miles from the sea, and is on a tributary stream about 1 mile back from the main river. It is composed of swamp and slightly hilly ground. Padi has been planted for some years both in the swampy parts and on the higher land. the sample is from the rising ground. Fairly big jungle surrounds the cleared swamp. The lower land seems well above the influence of tides, but would be under water perhaps as much as 3 or 4 feet in floods.

<u>Sample 3.</u> This is from a place about 9 miles from the sea, and lies behind a small range of hills running along river bank. The ~~hill~~ range slopes inland, and at a distance of about ¼ mile back, the land becomes flat and just above the level of swamp on both sides of it. It would be very wet in rainy weather, + would be flooded in flood times. It is covered with very fine jungle

trees, the finest seen in any of the lower reaches of the Kuantan river; and the undergrowth is spare. Hill Padi has been successfully grown on the higher ground towards the range.

<u>Sample 4</u> is from land about 16 miles from sea. It is from the left bank of a tributary stream about 1 mile back from main river. The land is some 10 feet above river level and has been, in places, used for hill padi growing.

<u>Sample 5</u> is from the right bank of No 4 stream, but from lower land. The land on both sides of this stream is alternately swampy and up to 10 or 12 ft high, the swampy parts being matted with roots which would cause great trouble in clearing, doubtless.

Agricultural Chemistry Laboratory.

University College of Wales.

Aberystwyth.

To The [illegible] Corporation Limited.

[illegible] House,

London Wall. E.C.

A REPORT upon examination of soils by John Alan Murray, B.Sc., F.C.S., Lecturer on Agricultural Chemistry in the University College of Wales, Aberystwyth: Agricultural Analyst for the counties of Merioneth, Montgomery, Cardigan, Carmarthen, Pembroke and Radnor.

....

[illegible]

[illegible] June. [illegible].

The samples were enclosed in separate canvas bags, marked 1, 2, 3, 4, 5 and 6 respectively, packed in a box sent from Singapore to London, thence forwarded to me unopened, and were received here on the 6th of October, 1897.

These samples, which were taken from different parts of the Company's Territory in the Malay Peninsula, were found to consist of air-dried specimens each representing the soil of the particular locality to a depth of three feet, and were chiefly used in the determinations of the chemical composition of the soils.

At my request, however, three further samples of the soil "in situ" to a depth of 12 inches were procured and were chiefly used by me for examination of the physical properties. They were forwarded to me direct in closed tins marked A, B, and C respectively and were received here on the 13th of May, 1898.

The soils exhibit a striking similarity both in physical properties and in chemical composition and have apparently all been formed under and exposed to similar natural conditions.

From the facts that the first lot of samples represent the soil to a depth of three feet and that each appears to be uniform throughout, I gather that the deposit must be of considerable ~~[illegible]~~ depth - a fact of no little importance in the cultivation of tropical plants many of which have long tap roots.

The soil particles have an average (true) specific gravity of 2.65 and, for the most part, appear to consist of a partially hydrated silicate of alumina mixed with a varying, but unusually, small proportion of quartz sand; colloidal clay, however, is entirely absent. The material is probably derived from the disintegration of the felspathic matter of granitic rocks, but it is difficult to form a reliable opinion on this point as absolutely nothing which could be called a stone or fragment of the original rock was found in the samples.

The state of division of the particles is, on the contrary, extremely fine. Practically all the particles have an average

diameter of less than one-thirtieth part of an inch and nearly sixty per cent of them have an average diameter of less than one-hundredth part of an inch (i.e. pass through a sieve which has a hundred wires to the inch). It will be observed that samples "3" and "9" are somewhat exceptional in this respect, the former being rather finer and the latter markedly coarser than the average.

<u>The soil in mass,</u> in consequence of this condition, possesses, approximately, the properties of a clay medium but, owing to the absence of coagulable matter, it is free from some of the more objectionable features of that substance. Thus, it is very finely porous and, when wet, is plastic and adhesive but will probably be found to be more easily worked than ordinary stiff clays, and as it allows of some ready percolation of water it is not so liable to become waterlogged and cause rotting of the roots of plants.

<u>In relation to water</u> the properties of the soils are eminently satisfactory. They can contain large quantities of water, and when the point of saturation is reached the excess passes downward with fair rapidity, and when fully drained they still remain nearly saturated. The co-efficient of evaporation is relatively low and, conversely, the power of absorbing water and gases from the atmosphere fairly high. The capillary power of the soils, again, is very great, i.e. when dry they can raise water from considerable depth against the influence of gravitation but, of course, the movement of the water is necessarily slow. This property is one of great importance for it tends to keep the upper layers of the soil moist in dry weather. On the other hand, in periods of prolonged drought such as these soils will have to withstand it tends to promote evaporation by raising the water to the surface. This tendency can, however, be greatly reduced by keeping the immediate surface layer (say a couple of inches) in a loose condition; this layer would act-

become very dry but as water would not so readily pass into it by capillary action the lower depths of the soil would remain more moist.

<u>The colour</u> of the soils in the dry state is a light greyish pink which changes to a redder appearance on cultivation owing to further oxidation of compounds of iron, but there is nothing to indicate that the soils are insufficiently supplied with oxygen in their natural state. The light colour of the soils will enable them to reflect a large amount of heat and so tend to keep them cool.

<u>The shrinkage</u> of the soils on drying is considerable. They lose nearly twenty-two per cent of their volume in passing from the saturated to the dry conditions and must therefore exert considerable pressure on the roots of plants. Shrinking also produces cracks which seriously interfere with irrigation. As, however, they do not dry very rapidly, I do not anticipate any very serious results from this cause.

<u>The proportion of organic matter</u> (humus) cannot be estimated in these soils by the ordinary direct process of simple ignition as water of combination is eliminated at the same time but it may be arrived at with tolerable accuracy from consideration of the proportions of carbon and nitrogen which they contain. On the average it appears to range from one and a half to two and a half per cent of the dry matter. This quantity though small is not much below the average commonly found in tropical climates and the soils must not therefore be regarded as seriously deficient in this respect.

The aqueous extract of the soil exhibits a slight degree of <u>alkaline reaction</u> owing, apparently, to the presence of small quantities of alkaline carbonates and silicates.

<u>The Plant Foods</u> (i.e. mineral substances essential for the growth of plants) may be conveniently divided into three classes or states as follows - (1) soluble in cold dilute acids, (2) insoluble in cold dilute acids but soluble in hot concentrated

acids (3) insoluble in hot concentrated acids. The first class includes all the materials at present in a condition available for the plants; the second class includes the first and also a reserve store of substances not at present in an available condition but which will gradually change into that state; the third class consists of fragments of undecomposed or only partially decomposed minerals from which the second and first class are derived, but I consider that, in material of this character, these changes will proceed very slowly especially in a tropical climate.

The insoluble matter constitutes from eighty to ninety per cent of the dry matter and consists chiefly of free silica (quartz) and of silicate of alumina with about two per cent of potash.

The substances dissolved by hot concentrated acids amounts to about nine per cent of the dry matter in each of the first three samples, to about thirteen per cent in sample "D" and to a much smaller quantity in each of the two remaining samples. It consists largely of oxides of iron and aluminium; the proportion of other ingredients - of which phosphoric acid, potash, magnesia and lime are the most important- are so small that the soils must be regarded as deficient in these ingredients. Indeed under any system of cultivation in which heavy crops were frequently removed from the land the whole stock would in all probability become rapidly exhausted.

The available potash and phosphoric acid are the only ingredients which it is necessary to estimate in the first class and it will be noticed that the quantities found ~~ak~~ are extremely minute. They are certainly far below what is found to be necessary for a high degree of fertility in English soils and even allowing for the climate I am of opinion that the soils are actually deficient in these two important substances.

To summarise briefly then, it may be said that the results of the various tests show clearly that, as regards their physical properties, the soils are excellently adapted for tropical

cultivation but as regards chemical composition they are more or less deficient in organic matter, lime and available potash and phosphoric acid. The former is, however, by far the most important consideration for in hot climates it is often difficult to maintain an adequate supply of water in the soils and at the same time to prevent them from becoming sodden. Moreover it is always difficult to effect any great ~~change~~ changes in the physical properties of soils and on large areas of land such attempts would be quite impracticable whereas the deficiencies in chemical composition may be comparatively easily made good by tillage and judicious manuring.

<u>The most suitable kind of produce</u> for the land is obviously a question that cannot properly be determined apart from economic considerations, climatic conditions and a great variety of other important considerations regarding which I possess very little information beyond what is contained in Mr Robert Latta's letter of the 10th of March and the accompanying sketch. In the following remarks therefore I have assumed that the Company would desire to grow various kinds of drugs, dyes, fruits, foods, spices &c. and that the climate is favourable for the growth of such crops but it is to be observed that my conclusions are based almost exclusively upon consideration of the properties of the soils.

<u>Medicinal plants</u> such as Cinchona, Castor seeds, Jalap &c. and <u>fruits</u>, with the exception of Bananas and possibly also of Cocoanuts would, I expect, be more likely to prove a source of trouble and disappointment than of profit as the soil does not appear to be of the most suitable character for their growth. These plants thrive best on a lighter class of soil, they require larger proportions of potash, lime and plant foods generally and they are said to have a very exhausting effect on the land. Pine apples have proved a complete failure on soils of similar character and Oranges might be expected to give but a poor yield even if the plants remained healthy. Bananas, on the other hand, as

I have indicated above, should be extremely small and the low land near the river, if not swampy, seems to be tolerably well adapted for the growth of Cocoa-nuts which would not suffer much by occasional flooding.

The Castor oil plant is a hardy one and might thrive where other medicinal plants would not.

<u>Dye yielding plants</u> of various kinds appear to offer a more promising field for operations. Annatto and Logwood (if it may be said to be cultivated) might be expected to thrive extremely well and even Indigo and Turmeric, which are somewhat more difficult to cultivate, might be expected to succeed but they should be grown on the slopes.

<u>Spices</u> with possible exception of Ginger I should expect to be amongst the most profitable crops this land is capable of bearing. Pimento or "All-spice" and Cinnamon will probably give best results and may be grown on almost any part of the land but very satisfactory crops of nutmeg, cloves and pepper should also be obtained on the slopes.

Turmeric and ginger are usually grown together in India and if the former succeed the latter would probably also succeed as it is not so hardy as Turmeric.

<u>For Tea and Coffee</u> the soil appears to be particularly well adapted and in my opinion the higher lands, which Mr Botto says he has not considered, might be very conveniently utilised for this purpose if suitable varieties were obtained. Both Tea and Coffee have been successfully grown at elevation as great as 6,000 feet above sea level and some varieties do not thrive below 1000 feet.

<u>Tobacco</u> would in all probability give very poor results. The soil is not rich enough and is too stiff. The plant would suffer particularly from the deficiency of lime and potash.

<u>Sugar Cane</u>, so far as the general character of the soil is concerned, might do well enough on the lower levels but the deficiency of lime in the soil would probably prove fatal to the

success of this crop.

Food plants of some description would of course be a necessity and the land appears to be of very suitable quality for the growth of Rice and Ragi (Eleusine Coracana) and the millets generally. Yams and sweet potatoes might also be grown on the slopes but the finest qualities of these plants are not usually obtained on land of such stiff character.

In considering the foregoing opinion it should not be forgotten that, as I have already stated, the soil is susceptible of considerable improvement and indeed might be so modified as to render it fruitful for some plants for which it is not naturally so well adapted. Moreover the lighter and coarser character of sample "B" and the fact that (as I understand) it lies on a gentle slope and is therefore subject to free drainage, affords a strong indication that those plants which thrive best on light soils would be grown best in that locality, if at all.

The improvement of the soil is largely a question of expense and is to that extent beyond the scope of this report but I may suggest that any steps you may see fit to take for this purpose should take the direction of increasing the proportions humus, lime, and available potash and phosphoric acid.

Frequent application of heavy dressings of bulky organic manures, such as farm yard material would without doubt be the best way of effecting such improvement as it would not only increase the proportion of humus in the soil but also of available plant foods except lime. As, however, I feel bound to assume that such material could not be easily procured in anything like sufficient quantity I should advise a system (more or less continuous) of green crop manuring. On planted lands the green crop can be raised between the rows of trees or bushes and ploughed in about the time it comes to flower. In the West Indies the green crop is usually "Pigeon peas" or some variety of "Bengal beans" but in the East Indies "Sunn Hemp" is commonly preferred as cheaper and better. However, I think

say that any bulky leguminous plant, of which several are sure to be grown in the district, will do for the purpose. The process may be repeated almost without limit, except under very heavy shade, and in some places the constant ploughing in of weeds has been found nearly sufficient.

It will be quite obvious of course that this process of green manuring does not affect the poverty of the soil in respect of lime phosphates and potash. It accelerates the change from the non available to the available state but as it does not directly increase the proportions of these substances in the soil I feel strongly inclined to advise that they should be added. Unfortunately I cannot find any authentic accounts of liming in tropical climates and it is impossible to foretell exactly what the result of such an operation might be under the circumstances but I fully anticipate that it would be a remarkably good one not only by reason of the usefulness of lime to the plant but also on account of its action upon the other constituents of the soil. The records relating to the action of potash and phosphatic manures on the otherhand are numerous and definite enough and mostly point to the conclusion that these manures are of comparatively little value in the tropics. Nevertheless I am strongly of opinion that a trial should be made on the following lines:-

If the deposits of limestone which I understand occur in various parts of the Peninsula are of fairly good quality and are accessible from the Company's territory a piece of land should first be well limed and afterwards treated with superphosphate at the rate of from six to eight cwts per acre, - in this case potash manure would probably be unnecessary. If however lime cannot be obtained at moderate cost the piece of land should be given basic slag at the rate of from eight ~~[illegible]~~ to ten cwts per acre and sulphate of Potash at the rate of from two to four cwts per acre. If equally convenient perhaps both of these experiments might be tried and the results should afford a very clear

indication as to the profitableness or otherwise of both methods

If the plan of green manuring, which I have suggested, is adopted nitrogenous manures will become of less importance but where it is found necessary or desirable to employ them nitrate of soda will certainly be found to be the most suitable kind of for these soils and will I expect prove a very effective manure for many crops.

Whenever possible all artificial manures should be applied immediately after the rains have ceased. In any case where the land is subject to flooding it will probably be found advantageous to work these manures lightly into the soil in order to diminish risk of loss. Where the land is "swept" by the flood of course even this precaution would not be sufficient.

In conclusion I may add that constant cultivation is strongly recommended by many tropical farmers as a means of increasing the fertility of the land but it seems to me in the highest degree inadvisable to loosen the soil to any great depth at the beginning of the dry season especially if the land is under crop.

(Signed) J.Alan Murray.

B 2.16/20

Chemical Composition of Soils.
expressed in Ounces per cubic foot *

Number of Sample....	1.	2.	3.	4.	5	6.
Inorganic (mineral) matters dissolved by concentrated acids	ounces	ounces	ounces	ounces	ounces	ounces
Soda.	1.304	.711	.811	.695	1.259	.936.
i Potash.	1.092	1.063	1.063	.764	.668	1.252.
Magnesia.	.569	.459	1.211	1.491	.613	.828.
Lime.	1.448	.935	1.273	1.074	.656	.855.
Oxides of iron and aluminium.	80.913.	85.868	86.584	66.565	54.466	120.414.
Chlorine.	.381	.294	.349	.299	.340	.516.
Silica	2.886	2.598	3.343	2.455	2.185	2.706.
Carbonic acid.	3.144	1.154	2.417	3.233	3.074	2.597.
Sulphuric acid.	.601	.346	.472	.543	.655	.524.
ii Phosphoric acid.	.525	.903	.886	1.106	.985	1.160.
do Insoluble in concentrated acids.						
Potash.	22.197	19.911.	20.811	24.079	26.621	27.662.
Fluorine, loss etc.	1.385	.313.		3.340	.033.	
Silica (including free quartz)	342.280.	354.220	426.417	591.527	583.866	403.970
Oxides of iron and aluminium.	459.690	443.770	373.184	251.337	259.794.	361.782
iii Organic (vegetable) matters and combined water.	76.581	82.406	76.768	46.486	59.779.	76.550
Water evaporated at ordinary temperatures.	564.404.	568.235	568.752	497.450	518.293.	563.236.
Residual water evaporated at 212 d. Fahr.	30.596.	26.765	26.248.	15.422	13.671	26.764.
Total mass of one cubic foot.	1589.986.	1589.951	1590.589.	1507.866.	1526.968	1591.752.

i Containing Potash in an available state.	.119.	.159	.126	.150	.145	.107.
ii Containing Phosphoric acid in an available state.	.053	.054	.044	.041	.032	.025.
iii Containing { Nitrogen.	1.028	.741	.846	.786	.731	.847.
Containing { Carbon.	6.268	6.368	7.562	4.378.	6.865	6.467.

* These figures multiplied by 2722 will give the quantities (lbs). of each ingredient per acre. twelve inches deep.

Physical Properties of the Soil.

Mass and Volume relation

True specific gravity.	2.59.	Percentage of total space occupied by dry solid matter.	38.27.
Apparent specific gravity.	0.995	" " water	59.50.
Total mass of one cubic foot in situ.	99.4 lbs	" " air and gases.	2.23.

Relation of the Soil to Water.

One cubic foot of soil in situ can contain when fully saturated 38.7 lbs of water.
" " retain " " drained 37.9 " " "
" " was found to contain 37.1 " " "

Average rate of percolation of water through saturated soil = 2.17 inches of water in 24 hours.
Average rate of evaporation of water at 90d. Fahr = 0.37 "
Average rate of absorption of water vapour from atmosphere at 60d. Fahr. = 0.05 "
Capillarity: dry soil can raise water against the influence of gravitation to a height of over 30 inches.
- - - - - - - - - - at an average rate of 1.25 inches in 24 hours.
Water soaks into the dry soil under the influence of gravitation at an average rate of 4.4 " "

State of division of Samples.
Percentage of dry soil passed through.

Sample.	Meshes per square inch in sieve.			
	225	900	3600	10000.
1.	99.8	99.2	74.6	52.7
2.	100.0	99.1	77.9	60.8.
3.	100.0	99.9	92.1	71.6.
4.	100.0	99.6	80.8.	58.0.
5.	91.4	68.3.	35.5	16.1
6.	99.3	95.6	75.0	60.2
Mean	98.4	93.6	72.6	53.2.

Relative proportions of Sand and Clay
per cent.

Sample	1	2	3	4	5	6.
Free Quartz	5.58.	10.18.	13.07	39.91	55.52.	13.24.
Argillaceous matter	94.42	89.82	86.93	60.09	44.48	86.76

Chemical Composition of the Dry Matter of the Soil.
Per Cent.

Number of sample	1.	2.	3	4.	5.	6.
	per cent	per cent	per cent	per cent	per cent	per cent.
Inorganic (mineral) matters dissolved by concentrated acids.						
Soda.	.1311	.0751	.0815	.0699	.1266	.0941.
i. Potash.	.1098	.1068	.1069	.0768	.0672	.1258.
Magnesia.	.0572.	.0471	.1217.	.1499	.0616	.0833.
Lime.	.1456	.0940.	.1280	.1080	.0660	.0860.
Oxides of iron + aluminium	8.1320	8.63[illegible]0	8.7[illegible]20	6.6900	5.4740	12.1020.
Chlorine.	.0383	.0296	.0351	.0301	.0342	.0519.
Silica.	.2901	.2612	.3360	.2468	.2196	.2720.
Carbonic acid.	.3160	.1160	.2430	.3250	.3090	.2162.
Sulphuric acid.	.0604	.0348	.0475	.0546	.0659.	.0527
ii Phosphoric acid.	.0528	.0908.	.0891	.1112.	.0990	.1166
2o Insoluble in concentrated acids.						
Potash.	2.2309.	2.0011	2.[illegible]	2.4200.	2.6755.	2.7[illegible]01.
Fluorine, loss etc.	.1392.	.0315	[illegible]	.3357	.0034.	
Silica (including free quartz)	34.4000.	35.6000.	42.8560.	59.4500.	58.6800.	40.6000.
Oxides of iron and aluminium.	46.2000.	44.6000.	37.5060.	25.2600.	26.1100.	36.3600.
iii Organic (vegetable) matters and combined water.	7.6966.	8.2820.	7.7154	4.6720.	6.0080	7.6940.
	100.0000	100.0000	100.0613	100.0000	100.0000	100.6347.

	1.	2.	3	4.	5.	6.
i. Containing Potash in an available state.	.0120	.0160	.0172.	.0151	.0146	.0180.
ii Containing Phosphoric acid in an available state.	.0053.	.0055.	.0045	.0041	.0032	.0026.
iii Containing { Nitrogen.	.1034.	.0745	.0851	.0790	.0736	.0852.
iii Containing { Carbon.	.6300	.6400	.7600	.4400	.6900	.650.